Remarks

Status of application

Claims 1-60 were examined and stand rejected over prior art. The claims have been amended in an effort to further distinguish Applicant's claimed invention. Claims 41-60 have been canceled in order to expedite prosecution of the present application. In view of the below remarks and amendments herein, re-examination and reconsideration of the claims are respectfully requested.

The invention

Applicant's invention comprises a digital imaging system providing techniques for reducing the amount of processing power required by a given digital camera device and for reducing the bandwidth required for transmitting image information to a target platform. The system only performs a partial computation at the digital imager device employing an efficient color conversion process, using a GUV color space. After an RGB mosaic (image) is captured, the image is "companded" or quantized by representing it with less bits (e.g., companding from 10 bits to 8 bits). The image is then mapped from RGB color space to GUV color space, using an RGB-to-GUV transformation. In one embodiment, this conversion is deferred until the image is transferred to another device (e.g., server computer).

Once converted into GUV color space, the image may now be compressed, for instance using wavelet transform-based compression, and then transmitted, using wireless or wire-line transfer, to any desired target platform (e.g., desktop or server computer at a remote location). At the target platform, the GUV information may be restored in a non-compressed format and then further processed into a desired representation (e.g., standard format, such as JPEG). In this fashion, the GUV-based methodology avoids the inefficiency of remaining in RGB color space and avoids the computational complexity of converting to YUV color space, yet retains the benefits associated with YUV color space (e.g., de-correlation of image information).

Rejection under 35 U.S.C. Section 112, second paragraph

Claims 1-40 have been objected to under 35 U.S.C. Section 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter regarded as the invention. Claim 1 (line 11) recites limitation "the primary channel" which the Examiner objects to as unclear because of failure to show this limitation refers to limitation "primary and secondary channels" recited in line 3, claim 1, or limitation "primary and secondary channels" recited in line 5, claim 1. The Examiner raises a similar objection to independent claim 26. By implication, the dependent claims of both are similarly rejected.

Both claims have been amended to clarify that the recited limitation of "the primary channel" pertains to the primary channel of the second color space. It is believed that the foregoing amendment to the claims renders the claim language definite, thereby overcoming the objection.

Prior art rejections

A. Rejection under 35 U.S.C. Section 102(b): Rabbani et al.

Claims 1-7, 11-14, 16, 25-31, 35-38, 40 stand rejected under 35 U.S.C. Section 102 (b) as being anticipated by U.S. Patent No. 5,412,427 issued to Rabbani et al. (hereinafter, "Rabbani"). In regards to this rejection, the Examiner states the following:

> Rabbani et al. disclose an electronic camera utilizing image compression feedback for improved color processing, comprising receiving an image in a first color space RGB (R, 0, B, figures 6-7, column 5, lines 5-35); storing information describing a second color space (Y', (R-Y'), (B-Y') are stored in storage module 28); transforming the image into said second color space (color transformation 14, figures 6-7, column 5, lines 42-56); interpolating the primary channel (interpolation 24, figure 7, co]umn 5, lines 45-56); computing the secondary channels (summers [sic] 26a and 26b, figure 7, column 5, lines 45-56).

The claims have been amended to prevent such an interpretation.

Although the originally-filed claims are believed to distinguish over the art, the claims have been amended in an effort to further distinguish over the art and facilitate prosecution of the present application. Under Section 102, a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in the single prior art reference. (See, e.g., MPEP Section 2131.) As will be shown below, Rabbani fails to teach each and every element set forth in the amended claim 1 (as well as other dependent claims thereof), and therefore fails to establish anticipation of the amended claim under Section 102.

For example, claim 1 now includes the following claim limitations (shown in amended form):

> transferring the companded image to a server computer;
> storing information describing a second color space, said second color space including primary and secondary channels, said primary channel of said second color space corresponding to the primary channel of said first color space; and
> at the server computer, transforming the image into said second color space, including:
> interpolating the primary channel of said second color space to full resolution by interpolating missing Green pixels from said RGB mosaic, and
> computing the secondary channels of said second color space as differences from the primary channel of said second color, including performing substeps of:
> (i) computing one of said secondary channels of said second color space by differencing Red pixels with co-sited Green pixels interpolated from said RGB mosaic, and
> (ii) computing the other of said secondary channels of said second color space by differencing Blue pixels with co-sited Green pixels interpolated from said RGB mosaic.

(Independent claim 26 has been similarly amended.) As shown by the above amendment, the claim now makes it explicit that the claimed approach includes deferring the interpolation process and color space transformation until after the image data is transferred (e.g., from a source device, such as a small digital camera) to a server computer. This approach allows the

camera to forego resource requirements (e.g., processor and battery resources) that would otherwise be required for performing the traditional device-side processing, such as described by Rabanni.

There are other differences as well. In Applicant's approach, transforming to GUV color space entails the computation of the following color values per cell, G0, G1, G2, G3, U, V (i.e., a single U and V for a cell):

```
G0 = (Ga+Gb+G1+G2)/4
G3 = (G1+G2+Gc+Gd)/4
U = R0-G0+255
V = B3-G3+255
```

Here, the U plane in the GUV color space is computed from the particular Green pixels that are co-sited with corresponding Red pixels, which is referred to as `G0` in the above equations. Similarly, the V plane is computed from the particular Green pixels that are co-sited with corresponding Blue pixels; this is referred to above as `G3`. `G0` and `G3` are not the same record. These differences are highlighted in the amended claim 1, at substeps (i) and (ii).

This is not what is shown or described by Rabbani. Instead, Rabbani describes computation of a interpolated Green record, G_I. The same interpolated Green record, G_I, is used to form Rabbani's color difference records, as described by Rabbani as follows:

> The interpolated green record, denoted by G_I, is then used to form the color difference records (R-G_I) and (B-G_I), as depicted in FIG. 3, by summing the interpolated green record with the red and blue records in respective summing elements 26a and 26b.

As described above, Rabbani employs the G_I record to form both color difference records, (R-G_I) and (B-G_I).

Further, the amended claim 1 now recites the additional step pertaining to "companding", as follows:

while said image is in said first color space, companding the image by mapping the luminosity values captured at said RGB mosaic into a space that is more linear to a human eye;

Rabbani does not provide any teaching pertaining to companding, nor does Rabbani provide any teaching analogous to companding-like features.

A claim is anticipated under Section 102 only if each and every element as set forth in the claim is found, either expressly or inherently described, in the single prior art reference. As Rabbani fails to teach each and every element set forth in claim 1 (and corresponding independent claim 26), as well as the other claims dependent from claim 1 (and corresponding dependent claims of claim 26), Rabbani fails to establish anticipation of the claimed invention under Section 102.

B. First Rejection under 35 U.S.C. Section 103(a): Rabbani et al.

Claims 17-21 stand rejected under 35 U.S.C. Section 103(a) as being unpatentable over Rabbani et al. (above). Here, the Examiner states that Rabbani does not including any teaching pertaining to Applicant's claim steps that set forth additional features of transforming an image back into non-compressed format, as well as transforming the image into different formats or color spaces. The claims, which depend from claim 1, are believed to be allowable for at least the reasons cited above pertaining to the deficiencies of Rabbani (during rejection of parent claim 1).

By virtue of the above-described amendment to base claim 1, claims 17-21 now include the explicit limitation that the color interpolation and color space transformation steps occur, not at the device itself, but at a server computer to which the information has been transferred. After the image has undergone interpolation and transformation steps at the server, the image may then be further converted to other formats or color spaces. The claim language, taken as a whole, requires the transmission of a partially-processed image to a server that, in turn, completes the processing. Then, the server may further process the image into other target formats. Since the claims include claim limitations that are not described by

Rabbani, by virtue of the amendment to base claim 1, it is respectfully submitted that the claims distinguish over that reference.

C. Second Rejection under 35 U.S.C. Section 103(a): Rabbani and Wang

Claims 8-10, 23-24, and 32-34 stand rejected under 35 U.S.C. Section 103(a) as being unpatentable over Rabbani et al. (above) in view of Wang et al. (USP 5,682,152, hereinafter "Wang"). Here, the Examiner states that Rabbani does not including any teaching pertaining to Applicant's claim steps that set forth additional features of transforming using using, for example, transform-based compression (e.g., claim 8), wavelet transform-based compression (e.g., claim 9), or DCT- (discrete cosine transformation) based compression (e.g., claim 10). Claims 8-10, and 23-24 depend from claim 1 and are believed to be allowable for at least the reasons cited above pertaining to the deficiencies of Rabbani (during rejection of parent claim 1). Claims 32-34 depend from base claim 26. Those claims are similarly believed to be allowable for at least the reasons cited above pertaining to the deficiencies of Rabbani, as discussed above in the rejection pertaining to parent claim 26.

D. Third Rejection under 35 U.S.C. Section 103(a): Rabbani and Fukuoka

Claims 15 and 39 stand rejected under 35 U.S.C. Section 103(a) as being unpatentable over Rabbani et al. (above) in view of Fukuoka (USP 5,754,227, hereinafter "Fukuoka"). Regarding this rejection, the Examiner states that Rabbani et al. fail to specifically disclose that a transmitting step is performed using wireless transmission. Thus, the Examiner turns to Fukuoka for the teaching that images captured by a camera can be transferred through an I/O card which functions as a modem connected to an online service such as AOL. Claim 15 depends from claim 1 and is believed to be allowable for at least the reasons cited above pertaining to the deficiencies of Rabbani (during rejection of parent claim 1). Claims 39 depends from base claim 26. The claim is believed to be allowable for at least the reasons cited above pertaining to the deficiencies of Rabbani, as discussed below in the rejection pertaining to parent claim 26. Fukuoka does not provide any teaching analogous to Applicant's deferral of processing (e.g., deferral of interpolation and transformation) as now

required by Applicant's amended base claims 1 and 26. Since Fukuoka does not remedy the deficiency of Rabbani, the combined references do not teach or suggest all of the claim limitations of Applicant's amended claims (and their dependents) and thus do not establish prima facie obviousness under Section 103.

E. Fourth Rejection under 35 U.S.C. Section 103(a):

Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rabbani et al. (above) in view of Tsai et al. (USP 5,172,227, hereinafter "Tsai"). Regarding claim 22, the Examiner acknowledges Rabbani fails to specifically disclose wherein the interpolating step applies averaging technique. However, the Examiner states that it would have been obvious to one skilled in the art to modify the device in Rabbani with the teaching of Tsai which references teaching compression with color interpolation in which the missing green pixels are computed by using the center weight average (column 8, lines 7-40). Claim 22 depends from claim 1 and is believed to be allowable for at least the reasons cited above pertaining to the deficiencies of Rabbani (during rejection of parent claim 1). Tsai does not provide any teaching analogous to Applicant's deferral of processing now set forth in amended base claim 1. Since the combined references do not teach or suggest all of Applicant's claim elements, they do not establish prima facie obviousness under Section 103.

F. Fifth, Sixth, and Seventh Rejections under 35 USC Section 103

Claims 41, 43, 48-54, 58-60 stand rejected under 35 U.S.C. Section 103(a) as being unpatentable over U.S. Patent No. 5,412,427 issued to Rabbani in view of U.S. Patent No. 6,008,847 issued to Bauchspies (hereinafter, "Bauchspies"). Claims 42 and 55-57 stand rejected under 35 U.S.C. Section 103(a) as being unpatentable over U.S. Patent No. 5,412,427 issued to Rabbani in view of U.S. Patent No. 6,008,847 issued to Bauchspies, further in view of U.S. Patent No. 5,754,227 issued to Fukouoka. Claims 44-47 stand rejected under 35 U.S.C. Section 103(a) as being unpatentable over U.S. Patent No. 5,412,427 issued to Rabbani in view of U.S. Patent No. 6,008,847 issued to Bauchspies, further in view of U.S. Patent No. 5,682,152 issued to Wang. In an effort to expedite

prosecution of the present application, claims 41-60 have been canceled, thus dispensing with the rejections of these claims.

Conclusion

In view of the foregoing remarks and the amendment to the claims, it is believed that all claims are now in condition for allowance. Hence, it is respectfully requested that the application be passed to issue at an early date.

Appended herewith is an attachment captioned "Version with markings to show changes made" presenting a marked-up version of the changes made to the application by the current amendment. An attachment captioned "Clean-copy Version of Claims" showing all remaining claims, in clean form, is also included. If for any reason the Examiner feels that a telephone conference would in any way expedite prosecution of the subject application, the Examiner is invited to telephone the undersigned at (408) 395-8819.

Respectfully submitted,

Date: April 2, 2002

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Version with markings to show changes made

In the specification,

Marked-up version of the replacement paragraph(s)/section(s), pursuant to 37 CFR 1.121(b)(1)(iii):

There are no amendments to the specification.

In the claims,

Marked-up version of the amended claims, pursuant to 37 CFR 1.121(c)(1)(ii):

Claim 1 has been amended as follows:

1. (Amended) A method for processing image information, the method comprising:

receiving an image in a first color space from an RGB (Red, Green, Blue) mosaic, said image including luminosity values captured at said RGB mosaic, said first color space including primary (Green) and secondary (Red, Blue) channels;

while said image is in said first color space, companding the image by mapping the luminosity values captured at said RGB mosaic into a space that is more linear to a human eye;

transferring the companded image to a server computer;

storing information describing a second color space, said second color space including primary and secondary channels, said primary channel of said second color space corresponding to the primary channel of said first color space; and

at the server computer, transforming the image into said second color space, including:

interpolating the primary channel of said second color space to full resolution by interpolating missing Green pixels from said RGB mosaic, and

computing the secondary channels of said second color space as differences from the primary channel of said second color, including performing substeps of:

(i) computing one of said secondary channels of said second color space by differencing Red pixels with co-sited Green pixels interpolated from said RGB mosaic, and

(ii) computing the other of said secondary channels of said second color space by differencing Blue pixels with co-sited Green pixels interpolated from said RGB mosaic.

Claim 26 has been amended as follows:

26. (Amended) A method for transforming RGB image information into an efficient color space representation, the method comprising:

receiving an image in a first color space from an RGB (Red, Green, Blue) mosaic, said first color space comprising an RGB color space having a primary channel comprising Green (G) and secondary channels comprising Red (R) and Blue (B), said image including luminosity values captured at said RGB mosaic;

while said image is in said first color space, companding the image by mapping the luminosity values captured at said RGB mosaic into a space that is more linear to a human eye;

transferring the companded image to a server computer;

storing information describing a second color space having primary and secondary channels, said primary channel of said second color space comprising Green (G); and

at the server computer, transforming the image into said second color space, including:

interpolating the primary channel of said second color space to full resolution by interpolating missing Green pixels from said RGB mosaic, and

computing the secondary channels of said second color space as differences from the primary channel of said second color space, by differencing Red pixels with co-sited Green pixels interpolated from said RGB mosaic and differencing Blue pixels with co-sited Green pixels interpolated from said RGB mosaic.

Claims 41-60 have been canceled.